MAIN STREET BRIDGE

The bridge is a single-rib tied steel arch

As the new century dawned over Columbus, Ohio, civic leaders faced a difficult transportation challenge. Time, weather and traffic had taken their toll on one of the city's primary arteries, a multiple-span, open-spandrel concrete deck arch bridge built in 1937, degrading it to such an extent that it had to be closed. Its deteriorated condition meant that the Main Street Bridge needed replacing - and with a structure that suited the city's unique heritage and bright future.

The initial concept was designed by Dr Spiro Pollalis, professor of design technology and management at the Harvard University Graduate School of Design. He was appointed by the city authorities who had seen other bridges designed by him. After a remarkably public decision-making process, the leaders and citizens of Columbus chose the final design for the new Main Street Bridge, which is owned by the Ohio Department of Transportation and managed by the City of Columbus. Leading the design process are two companies with local roots and experience: DLZ Ohio, a Columbus-based architectural, engineering and environmental services company holds overall project management responsibility for the Main Street Bridge design team. DLZ designed the bridge's substructure and is handling traffic management, railing design, geotechnical engineering and approach roadway work.

DLZ selected HNTB as a partner based on its work on large, complex bridges and other successful projects in Ohio. HNTB is the lead structural design firm, carrying out structural analysis and structural design of the Main Street Bridge, and designing the superstructure.

The US$42 million Main Street Bridge project will be an iconic structure, and is intended to contribute to the revitalization of the city by linking parks and communities in Franklinton, the oldest part of the city, with the downtown core on the east side of the Scioto River. An inclined single-rib tied arch bridge - believed to be the first of its kind in the United States, and one of only a few in the world - will carry vehicle and pedestrian traffic and is intended to revolutionize the skyline.

Recognizing that rehabilitating the existing bridge would cost nearly as much as building a new one, leaders in Columbus determined early in the process that the city deserved a signature replacement bridge. With neighboring arch bridges and an art deco heritage of arches throughout the city, clean, classical lines were considered an important design element of the new structure. The bridge needed to add value to urban and regional development plans - not just provide a way to cross the river - and create desirable public spaces. The bridge would also need to serve both vehicular and pedestrian traffic, a decision that helped drive the project's progressive visual elements.

The basic requirements were that the structure should have a 100-year lifespan, a clear entrance and exit, and be pedestrian-friendly. The design criteria were established by the stakeholders, including state and federal transportation officials, city leaders, the state historic preservation office, the Franklin County engineer, developers of a high-rise residential complex near the bridge, the Greater Columbus Arts Council and the downtown association, among others.

The structure was to be compatible with the neighboring Broad Street Bridge, which has recently been renovated and is the primary artery into the downtown area. It was intended to embody the architectural character of the civic centre historic district and provide motorists and pedestrians an unobstructed view of the water and skyline.

The bridge was also required to incorporate high-performance materials whose durability would help achieve the 100 year life span of the bridge. Other requirements were that it should accommodate contemporary and future vehicular, bicycle and pedestrian traffic needs for the expected addition of 400,000 residents during the next 20 years, and that it should provide a link to the Riverwalk, another civic project currently under design.

In addition the structure was required to accommodate several public festivals held annually during the summer and to offer relatively maintenance-free service.

The design teams held a two-day charrette to develop concepts, generating about 50 initial ideas which were narrowed down to six designs to be presented to the mayor and city officials. They selected three designs on which the public were invited to vote.

The design team developed an architecturally-significant bridge designed to provide a number of key elements. A single-rib tied steel arch inclined at a 10-degree angle from vertical, and an asymmetrical cross-section emphasizing the role of pedestrians and bicyclists.

The structure has three vehicle lanes to accommodate eastbound traffic across the Scioto River, a 2m-wide pedestrian walkway on the south side of the bridge, and a 6m-wide pedestrian deck that sweeps horizontally and vertically away from the road to provide an unobstructed view of the city.

The bridge has a steel box girder roadway and a concrete pedestrian path, and was designed with piers that complement the superstructure design. The simple, yet sculptural, design that emerged starts as a single, unified section from both ends, gradually rising as it separates into three lanes for vehicle traffic and a fourth lane for bicycle and pedestrian traffic.

Because the city wanted a structure that would also be an architectural feature, aesthetics and attention to detail were critical to the design. Elegant roadway and pedestrian lighting, splice plates placed inside the bridge to give a smoother outside appearance and post spacing that matches other bridge elements help to meet these goals.

The designers were also careful to choose individual elements that are aesthetically pleasing. For example, the steel arch will emerge through the bridge deck and steel hangers will come down from the arch. The hangers have both engineering and an aesthetic purpose, enhancing the lines of the structure while supporting the members below the deck.

Because of the budget, steel, rather than concrete, played a significant role in the bridge design. A concrete bridge would have exceeded the budget, but steel will make it possible to build the inclined arch design, and also to achieve a quicker construction process. Steel elements will make it quicker to erect the structure, minimizing the time the temporary supports will be exposed to potential flooding.

Design drove other materials considerations as well. For example, the handrail has an aluminum finish that will not corrode or require maintenance, and concrete on the bridge is colored for aesthetic reasons. The team chose steel boxes to support the road deck which reduced the bridge load.

Removal of the old bridge took place in the autumn of last year, after which the contractor Kokosing Construction Company ordered the steel for the bridge, which will take about a year to fabricate by subcontractor PDM Bridge. In the meantime, foundation and substructure construction is under way. Four temporary falsework towers will be erected along the length of the roadway box girder to support the vehicular steel box, along with two taller falsework towers to support the arch's construction. Jansen & Spaans is the construction engineer.

After building the steel box and arch, the contractor will install floor beams to support the pedestrian deck on the north side and the permanent struts and hangers for the arch. This will allow construction of the pedestrian and bridge decks before all the falsework towers are removed.

The bridge's overall length is approximately 202m, which consists of three spans; a main span of 122m and two side spans of 40m each. Meanwhile, the three-lane vehicular deck is 10.7m wide, and the pedestrian walkway is 5.5m wide, providing an area from which people can view the skyline to the north. The pedestrian bridge is about 9m from the roadway, connected by cables that tie from the floor to the L-struts that support the structure, and 1.2m above it.

The Main Street Bridge is believed to be the first example of an inclined arch tied together with cables and struts; it will also be the world's first single inclined arch bridge that incorporates both pedestrian and vehicular decks. It is slated to open in June 2009.

James Siebert is DLZ Ohio project principal/project manager and Steve Hague is HNTB project manager for the Columbus Main Street Bridge project

Main Street Bridge in Columbus, Ohio

Prof. Pollalis's latest bridge project is the replacement of the Main Street Bridge in Columbus, Ohio, a bridge that serves as a key element of the revitalization of the Columbus Civic Center. The bridge is a low arch, 700 foot long (215 m) over the Scioto River, with construction scheduled to start in October 2005.

Prof. Pollalis's belief is that bridges have crossed the engineering boundaries and have entered the discourse of architecture. Bridges add value to urban and regional development and create desirable public spaces. Pedestrian-friendly bridges are suitable to make statements, attract inhabitants and visitors, and provide a symbol for the built environment that identifies and sets apart the new developments, giving them an edge in regional competition. Often, bridges become the prominent part of large public projects.

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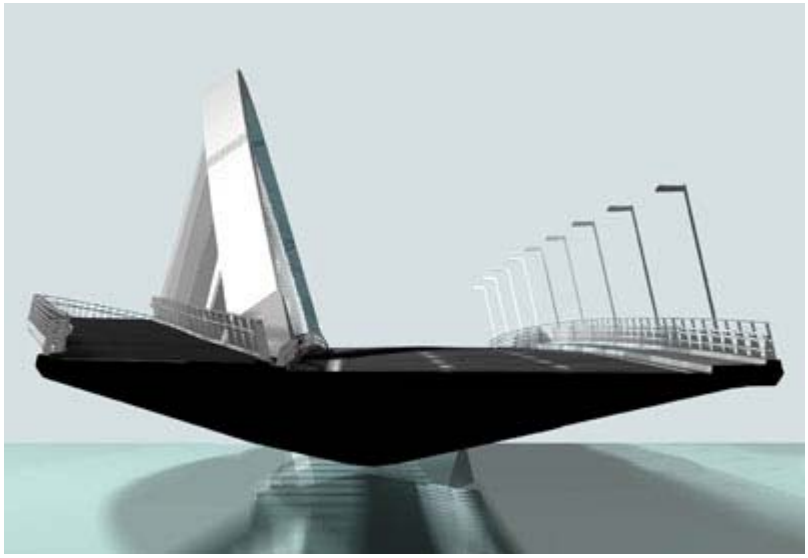
Main Street Bridge, Columbus, Ohio,
model-rendering: Yuki Nikitaki-Panajotis Mihalatos

Furthermore, bridges offer an alternative to large-scale sculptures and ornamental structures. By embodying art in the utilitarian structure of a bridge, the power of art increases and, with the curiosity of the laymen on how the bridge functions, makes a lasting impression on people, often more effective than other works of architecture could achieve. Thus, seeking a symbol for their cities or neighborhoods, a magnet for attracting people and as a booster for development, authorities are willing to reconsider the commissioning of bridge design and entertain the idea of allowing the designers to explore innovative ways of spanning from A to B.

Main Street Bridge, Columbus, Ohio,
model-rendering: Yuki Nikitaki-Panajotis Mihalatos

Within the above school of though, Prof. Pollalis has designed the Main Street Bridge in downtown Columbus. This bridge epitomizes his approach to bridge design by emphasizing the role of pedestrians and bicyclists in the design of an asymmetrical cross-section, as well a sculptural approach to the various elements of the bridge with a constrained departure of traditional engineering practice. At the same time, exaggerations are avoided, maintaining a good engineering practice and simplicity.



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